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Land use planning based on the connectivity of tree species does not ensure the conservation of forest biodiversity

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ABSTRACT

Amidst rapid global climate change and at a time when many adaptive policies and strategies have been implemented, reductionism in forest management decisions may have detrimental effects on forest biodiversity. Stăncioiu et al. (2018) made an important contribution by assessing forest connectivity based on tree species populations in Romania. Their study concluded that current management policies and inherited guidelines from the past likely promoted the conservation of regional biodiversity. In this viewpoint paper, we present a different perspective on their conclusion. We show that current management policies are threatening biodiversity in Romania, and changes in forest management policies are urgently needed to halt the loss of habitats of protected species. Although recent management policies likely did lead to good tree species connectivity, habitats of protected species are becoming increasingly fragmented by logging. Adopting policies to protect forest habitats of protected species, limiting large-scale salvage logging within protected areas, and restricting road building to reduce forest fragmentation are crucial steps towards the long-term persistence of biodiversity hotspots in the Romanian Carpathians.

1. Introduction

In recent decades there has been a trend of large-scale destruction of mountain forests by clear-felling, salvage logging, and illegal logging across the entire Carpathian region, which encompasses many European biodiversity hotspots (Kuemmerle et al., 2009; Knorn et al., 2012a,b; Griffiths et al., 2014; Mikoláš et al., 2017a). Forests are exposed to increased pressure of rapidly developing forest management technology and forest product demands. Road construction increases accessibility to mountainous areas that have been largely protected due to their inaccessibility. In protected areas of Romania, such as national parks, natural parks, or NATURA 2000, large-scale logging is permitted (Knorn et al., 2012b; Mikoláš et al., 2017a). In a recent paper entitled "Forestland connectivity in Romania—Implications for policy and management", Stăncioiu et al. (2018) assessed the spatial distribution and degree of forest connectivity in Romania based on forest tree species connectivity. Their study concluded that management policies and guidelines inherited from the past provide good conditions to promote forest tree species connectivity, and, therefore, that such conditions likely lead to biodiversity conservation by creating habitat conditions required by most forest-dwelling species. We are concerned that misinterpretation and simplification of such conclusions may support further destruction of habitats of protected species and may accelerate biodiversity loss.

2. Forest tree species connectivity alone does not ensure biodiversity

To exemplify a different effect of management practices on forest connectivity in the Romanian Carpathians, we use a study of a protected forest species, the capercaillie (*Tetrao urogallus*). Mikoláš et al. (2017a) showed a dramatic decline of forest habitat connectivity for the capercaillie in the Carpathians, which includes the same study area of Stăncioiu et al. (2018). Capercaillie is a ground-dwelling bird

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considered to be an umbrella species of the montane forests whose habitat requirements overlap with the habitat requirements of a wide range of other protected forest species. Declining connectivity of capercaillie habitat in the region would suggest that other species may be experiencing similar constraints, thus limiting biodiversity, which is in direct contrast to Stăncioiu et al. (2018) conclusions regarding forest connectivity based on tree species alone, which we would argue does not ensure biodiversity conservation.

Between 1985 and 2010, about 56,500 ha of potentially suitable capercaillie forests were logged in Romania. Moreover, recent logging operations (e.g., salvage logging, large-scale illegal logging, and likely logging of forests regrowing on old pastures) of the region have led to the destruction and fragmentation of capercaillie habitat (Mikoláš et al., 2015, 2017a). As a result, habitat connectivity declined by 33% (Mikoláš et al., 2017a). These degraded capercaillie habitats largely corresponded to spruce-dominated forests, where Stăncioiu et al. (2018) assessed high connectivity levels based on a variety of tree species. Capercaillie requires specific habitat elements typical of mature and old-growth stages of forest development, such as semi-open forest habitats, presence of low-branched trees, high ground vegetation cover, snags, and uprooted trees (Bollmann et al., 2005; Mikoláš et al., 2017b). Those conditions are the result of forest development driven by natural disturbances, such as windthrow and bark beetle mortality, in unmanaged forests (Meigs et al., 2017). The species cannot shift to forests with different structures (but the same tree species composition) and sustain viable populations over the long term (Grimm and Storch, 2000). After large-scale logging, suitable forest structures for the capercaillie usually reappear only after 80–120 years under classical forest management (Saniga, 2003).

Forest specialist species, such as capercaillie, but even more importantly, a diverse assemblage of species dependent on deadwood (e.g., insects, fungi, lichens, bryophytes), require specific habitat structures (Mikoláš et al., 2017b; Zemanová et al., 2017; Nagel et al., 2017; Thorn et al., 2018). Estimates suggest that those species represent more than 30% of the forest biodiversity, and many of them are red-listed species that form a key component of many forest communities (Siitonen, 2001). Commercial/classical forest management promotes stands that lack many of these critical structural-habitat elements that such specialists rely on (e.g., semi-open forest habitats, presence of low-branched trees, high ground vegetation cover, snags, lying dead wood, old-habitat trees, and vertically complex canopies). Such complex forest structures are an inherent component of unmanaged forests that develop under a regime of natural mortality and disturbance processes (e.g., Meigs et al., 2017; Nagel et al., 2017).

3. Inaccessibility does not protect the Romanian forests anymore

A high proportion of the forest biodiversity and habitats in Romania was arguably somewhat protected due to the former inaccessibility of many forests. Historically, it was difficult to access mountain areas and therefore no management or low-intensity management resulted in forests with structurally complex habitats in the remote regions of Romania (Meigs et al., 2017). Indeed, a large proportion of forests in the remote mountains was not necessarily untouched, but most have been developing without significant human interventions for decades and centuries. Romania is still among the countries with the lowest road densities in central Europe (Ibisch et al., 2016). However, new forest roads that reach these formerly inaccessible forests fragment habitats, facilitate heavy logging, hunting, poaching, and disturbance by tourism (Selva et al., 2011). All these actions may have detrimental effects on forest biodiversity in Romania, and can lead to extinction debt and genetic isolation of a wide range of forest species (Pullin, 2002). In particular, logging operations such as salvage logging (sanitary cutting) are a legal way to create clear cuts of unlimited sizes that can completely homogenize the landscape and destroy the forest habitats over the long-term (Fig. S1).

4. Adoption of new management policies to protect biodiversity

We suggest the adoption of new management policies with a strong focus on the creation of sufficiently large and well-connected networks of strict forest reserves to halt biodiversity loss in Romania (Nagel et al., 2017). Such reserves are biodiversity hotspots and also ensure "reference areas “important for adaptation of forest biodiversity under global change (Hannah et al., 2007). Only about 2% of Romanian forests are under strict protection according to the current legislation, which is a very low proportion of forest area considering the importance of this biodiversity hotspot for the European Union (FORESTS EUROPE, 2015). According to the recent virgin forest protection legislations, additional ca. 1% (ca. 100,000 ha) of forests could be potentially protected (Catalogue of the virgin forests Romania, 2018). However, such a target seems difficult to achieve, especially given that logging in primary forests continues. In comparison, Germany adopted a forest protection target in conjunction with the biodiversity strategy of 5% of the overall forest landscape (and 10% of publicly owned forest) until 2020 (National biodiversity strategy, 2007). Switzerland adopted an overall 10% forest protection target by 2030, whereby 5% of the forests will be strictly protected and 5% of the forests will be managed only for pre-defined biodiversity goals until 2030 (Switz forest policy, 2019). In Slovakia, recently ca. 4.5% of the forests are strictly protected and the target of the Envirostrategy proposed by the Slovak Ministry of Environment is to increase the area of strict reserves without any human intervention to 5% of the landscape, which means approximately 8–9% of the forests in Slovakia by 2030 (Envirostrategy, 2030). A target of 10% of the landscape is also suggested for forest conservation by Birdlife International (Hanski and Walsh, 2004). A target of 10% is acceptable if the sites selected for protection – or, if necessary, restoration – are carefully chosen so as to represent a wide variety of different forest types and to form a functional network of reserves (Hanski and Walsh, 2004). Increasing the area of strict reserves to only 10% may significantly strengthen both biodiversity conservation and short-term CO_2 sequestration (Nabuurs et al., 2017).

5. Conclusion

If biodiversity conservation is the target of future management and decision making in Romania, a more comprehensive analysis of suitable structural parameters and indicators (e.g., umbrella species, sensitive species, habitat association or functional guilds, species assemblages, habitat types) is needed for effective landscape conservation planning and policy decisions (Müller et al., 2007; Mikoláš et al., 2014). Urgent adoption of new management policies to protect biodiversity in Romania is critical.

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Appendix A. Supplementary data

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